Use of SUPERCALC to Compile and Report Statistics in Public Transportation

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ABSTRACT

The aim of this paper is to demonstrate the usefulness of commercially developed and widely available software for solving problems of data analysis and statistical evaluation in transportation planning and operations. As an example, SUPERCALC, developed by Sorcim Corporation, is applied to the study of public transportation usage. The problem-solving illustration is composed of three parts: the first part involves the design of a basic worksheet (template), the second demonstrates the definition of a bus line and the preparation of a field sheet, and the third describes the compilation of observed data and the preparation of final and intermediate reports. The sample application shows that fairly difficult problems, which formerly would have required a mainframe computer and specialized knowledge of computer programming, can now be handled by this user-friendly and easily understood software. The application described was implemented on an Osborne I (64K) computer, a typical modern microcomputer. The low cost of this and similar microcomputers makes them particularly appealing for small, medium, and even larger transportation agencies.

Microcomputers are penetrating more and more into our everyday lives. Because of their personal character and ready availability they have initiated a revolution in our calculation habits similar to the one brought about by electronic calculators. This development is only beginning and, as Sinkowitz and Manheim (1) suggest, ways of perceiving and solving problems may change completely because of the capabilities of these machines.

Development has been so rapid that software availability lags, and many of the newly developed programs for microcomputers still follow the old mainframe computer approach to programming without using the unique capabilities of the microcomputer to their fullest extent.

One of the advantages of the microcomputer is the availability of powerful commercial software developed for general applications such as wordprocessing programs (such as WORDSTAR), data management systems (such as DBASE II), and finally programs for handling numbers and complex mathematical equations (such as VISICALC or SUPERCALC and so on). These will be called "CALCs" in the remainder of this paper.

This latter type of software opens up enormous possibilities to the engineer working on the planning and operation of transportation systems because it does not require any specialized knowledge of programming languages but works somewhat like an enhanced electronic calculator. It allows the analyst to design field sheets, to compile data, and to produce reports easily and in an extremely user-friendly way. The concepts behind VISICALC, SUPERCALC, and the other CALCs are much the same and SUPERCALC (2) is used in this illustration. Some introductory explanations are necessary in order to understand the basics of this program. Its usefulness in transportation will then be illustrated by an application.

THE CALC PROGRAM

The memory of the microcomputer is subdivided into a worksheet or spreadsheet similar to a matrix with 63 columns and 254 rows. Each of these cells can contain data, complicated formulas, or alphanumeric information, or it can be used for graphic output. The width of the columns can be varied if necessary. Figure 1 shows an example of a worksheet.

For example, to calculate the length of the hypotenuse of a triangle whose two other sides are known, the formula \( \sqrt{A_1^2 + B_1^2} \) is entered into cell C1. The program then calculates the results for all possible values put into cells A1 and B1 and shows the result in cell C1. The formula is not displayed in cell C1 but is stored and can be displayed by putting the cursor under cell C1. The formula will then be displayed at the bottom of the worksheet as shown in Figure 1. The result of the calculation in cell C1 can then be used for other calculations in other cells.

The ability to handle alphanumeric data enables titles and row and column headings to be written on the worksheet so the results can be presented in an appealing way. The analyst designs a worksheet in the same way that work would be done manually on a sheet of paper and no programming knowledge is necessary. Yet the program ensures efficient and rapid work. In many circumstances, this approach is superior to and much faster than the classical programming approach, as will be illustrated later.

A number of interactive commands allow data entry, and the updating, editing, saving, and print-
APPLICATION OF CALC IN PUBLIC TRANSPORTATION

The principal aim of this paper is to illustrate an elegant and efficient way to solve some of the everyday problems encountered by the transit planner without using any heavy computer hardware.

APPLICATION OF CALC IN PUBLIC TRANSPORTATION

The particular usefulness of the microcomputer lies in its interactive capability. The computer operator, programmer, and analyst are all one person in this environment, reuniting the functions of design, calculation, and analysis that are essential in all engineering applications and that have been separated since the introduction of the mainframe computer. The feedback among data, program, and results is instantaneous and thus facilitates the engineer's work in design and daily operations, freeing him from dependence on computer programs and computer specialists.

Consider, as an example, the problem of transit route performance analysis and, especially, ridership reporting. Many programs exist in this field as is documented in the Software Source book of Microcomputers in Transportation (3), but these are mainly programs written in BASIC or similar programming languages.

Procedures for the study of public transportation use (4) are well known. There are several activities related to these studies:

- Definition of bus lines with lists of stops and the distances between them;
- Data acquisition on board transit vehicles by an observer; and
- Compilation for a given time period of statistics such as time series distribution, maximum load point, and passenger-kilometers.

In a traditional computer environment at least three procedures would have to be programmed: (a) update of the file of bus routes (stops, speeds, and so forth); (b) data acquisition, verification, and validation; and (c) preparation of the report.

In the microcomputer environment a similar design can be used, which is much simplified by the use of CALC. The procedure has four levels:

1. General design of the spreadsheet data structure and analysis, together with the design of a field sheet for this particular problem.
2. Preparation of the field sheet for the particular transit line to be studied. This sheet can be used by the observer on the bus. The sample sheet

![FIGURE 2 Basic worksheet.](image-url)
DESIGN OF THE BASIC WORKSHEET

The practical illustration is based on an example with 20 bus stops, but CALC allows the number of stops to be modified easily (up to 254 if the memory of the microcomputer is large enough) by inserting new stops or deleting existing ones.

At the beginning of the design procedure, the kind of report to be produced in terms of format and graphic or written output must be defined. In the example the following information was required:

- All information contained on the basic field sheet such as line number, weather conditions, capacity of the bus, and time of departure of the run;
- Number of each bus stop, its name and location;
- Cumulative distance of each bus stop from the starting point;
- Cumulative time of arrival at each bus stop; and
- Number of boarding and alighting passengers.

The final report should contain cumulative calculations for a chosen period of the day: for example, volumes of boarding and alighting passengers, the maximum point load, and a graphic display of the passenger load profile for one or more bus runs. The report should also identify by an asterisk those links, between two stops, on which the theoretical average overall travel time differs by more than 1 min from the observed time. Several global indicators of performance such as overall travel speed, passenger-kilometers, and volume-to-capacity ratio should also be given on the report sheet.

When this basic worksheet has been designed, it can be saved on a disk file and used for any bus line to be studied. The basic worksheet is shown in Figure 2. Rows 1 to 11 essentially contain titles and headings for the report and the field sheet. The actual calculations are done in columns J to V over rows 12 to 31 using data that are contained in columns C to I over rows 12 to 31. The formulas introduced into the worksheet are shown in Figure 3. They are not displayed on the worksheet and are repro-

FIGURE 3 Formulas stored in basic worksheet.
The observed data are introduced directly from the field sheet into the microcomputer in an interactive way. In the example there are three runs, B-Al, B-A2, and B-A3, on bus line 51 shown in Figure 5. The information is saved on disk file to be loaded later, if necessary, onto the basic worksheet of Figure 2.

FIELD SHEET

Using this basic design, a field sheet for a particular bus line can easily be prepared by saving from Figure 2 only columns A to I over rows 1 to 31 on a disk file. Adding the necessary information on bus stops such as location, distance, and travel time defines the field sheet shown in Figure 4. If separation lines are inserted, this sheet can be used directly on the bus (Figure 5).

FIGURE 4 Field sheet stored on disk file.

OBSERVED DATA

The observed data are introduced directly from the field sheet into the microcomputer in an interactive way. In the example there are three runs, B-Al, B-A2, and B-A3, on bus line 51 shown in Figure 6. The information is saved on disk file to be loaded later, if necessary, onto the basic worksheet of Figure 2.

REPORT

If a report is required for run B-Al, for example, the basic worksheet (Figure 2) is first loaded from disk file into the memory of the computer and then the contents of disk file B-Al are inserted (using the command /Load) into this worksheet, which is equivalent to filling out the cells in columns C to I and rows 12 to 31. This automatically initiates the calculations described by the formulas shown in Figure 3, and this produces the report (Figure 7) for this run. If an average for the three runs is required, files B-A2 and B-A3 are successively loaded onto the basic worksheet and the final report (Figure 8) is obtained for the peak hour.

CONCLUSIONS

The application of CALC to the case of transit surveys is efficient and fast. The worksheet can easily be adapted to fit all possible transit lines and titles; column headings and row headings can be modified as necessary for use by different transit authorities. The same basic CALC program can be adapted to other applications in the transit field; for example, to public transportation speed and delay studies. There are also many applications in the traffic engineering field such as spot speed studies and travel time and delay studies. These problems, which are extremely labor intensive and costly to solve, can now be tackled in a more global way by one person who designs the worksheet, inputs the data, and obtains the results, thus eliminating the time-consuming and costly intermediate steps of programming and analysis by a computer specialist.

The use of readily available and transferable mass-produced software such as CALC for the solution of day-to-day problems in transportation operations and planning is highly recommended, because it is
FIGURE 6 Observations of three bus runs on Line 51.
not only cheap and fast but requires no special knowledge of computer programming languages. The extremely user-friendly design of these mass-produced programs that contain no "bugs" provides an easy way to introduce computers at all levels of the transportation agency. This will help to demystify computers for engineers and planners now working in the field. The ease of use of these programs encourages more frequent applications because it is possible to produce interesting results without the long and hard apprenticeship necessary to work with a mainframe computer.

REFERENCES


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