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 1 (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 Simkowitz 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.

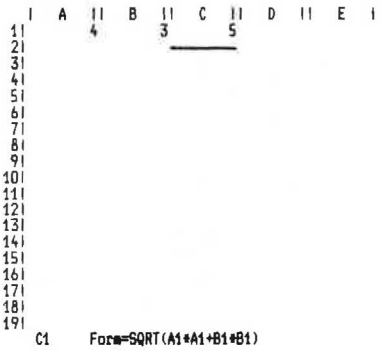

FIGURE 1 Simple problem solved by SUPERCALC.

For example, to calculate the length of the hypotenuse of a triangle whose two other sides are known, the formula SQRT(A1*A1 + B1*B1) 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-

ing of data and formulas in an extremely simple and user-friendly way. Some of these commands [see Osborne user's guide (2) or equivalent] include

- Data Commands
  - /Edit: Transfers cell contents to entry line for editing.
  - /Format: Specifies format for a given portion of the worksheet.
- Worksheet adjustment commands
  - /Delete: Erases data from a specified column or row.
  - /Insert: Inserts an empty column or row.
  - /Move: Relocates a column or a row of data.
  - /Copy: Duplicates data from source row or column to destination.
  - /Replicate: Replicates source until specified range is filled.
  - /Title: Provides method for fixing titles.
- File manipulation
  - /Load: Loads and displays part or all of a disk file.
  - /Save: Stores data from worksheet to disk.
  - /Output: Prints results to printer or disk.
- General commands
  - /Zap: Clears the entire worksheet of data.
  - /Quit: Exits from SUPERCALC.

The copy and replicate commands deserve special mention because they are particularly useful in multiplying data in the worksheet. The format command, which can be used to design a field sheet or final report, is also helpful.

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.

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

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	PUBLIC TRANSPORTATION USAGE R. Chapleau																					
2	----example of compilation----																					
3																						
4	LINE:I DATE: TEMP: CAP.: 75																					
5	I DAY:																					
6	run =																					
7	TOTAL NUMBER dir =																					
8	OF RUNS = 1 DIST. TIME start= CUMULATIVE																					
9	No. BUS (km) (min.) PASSENGERS Tmean PASSENGERS pass pass SPEED																					
10	STOP theor. obs. ON OFF (min) ON OFF IN km min theor. obs.																					
11																						
12	1						0	0	0	0	**********								1	0		
13	2						0	0	0	0	0	DERROR	ERROR						2	0		
14	3						0	0	0	0	0	DERROR	ERROR						3	0		
15	4						0	0	0	0	0	DERROR	ERROR						4	0		
16	5						0	0	0	0	0	DERROR	ERROR						5	0		
17	6						0	0	0	0	0	DERROR	ERROR						6	0		
18	7						0	0	0	0	0	DERROR	ERROR						7	0		
19	8						0	0	0	0	0	DERROR	ERROR						8	0		
20	9						0	0	0	0	0	DERROR	ERROR						9	0		
21	10						0	0	0	0	0	DERROR	ERROR						10	0		
22	11						0	0	0	0	0	DERROR	ERROR						11	0		
23	12						0	0	0	0	0	DERROR	ERROR						12	0		
24	13						0	0	0	0	0	DERROR	ERROR						13	0		
25	14						0	0	0	0	0	DERROR	ERROR						14	0		
26	15						0	0	0	0	0	DERROR	ERROR						15	0		
27	16						0	0	0	0	0	DERROR	ERROR						16	0		
28	17						0	0	0	0	0	DERROR	ERROR						17	0		
29	18						0	0	0	0	0	DERROR	ERROR						18	0		
30	19						0	0	0	0	0	DERROR	ERROR						19	0		
31	20						0	0	0	0	0	DERROR	ERROR						20	0		
32																						
33	TOTAL**** 0 0 0 0 0 0 0																					
34	on off ON OFF IN max																					
35	GLOBAL INDICATORS:																					
36	** km /pass = ERROR																					
37	** min/pass = ERROR																					
38	**ratio v/c = ERROR																					

FIGURE 2 Basic worksheet.

presented here follows closely the one used by the Montreal Urban Community Transit Commission.

3. Data entry on the field sheet and input of data to the microcomputer.
4. Preparation of intermediate and final reports.

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-

	A	I	C	D	E	F	G	H	I	J	R
1	PUBLIC TRANSPORTATION USAGE						R. Chapleau				
2	------example of compilation------										
3											
4	LINE:I	DATE:		TEMP:		CAP.: 75					
5	1	DAY:									
6						run =					
7	TOTAL NUMBER					dir =					
8	OF RUNS = 1		DIST.	TIME		start=					
9	No.	BUS	(km)	(min.)		PASSENGERS			Mean Travel Time		
10		STOP		theor.	obs.	Boarding		Alighting	(min)		
11											
12	1								(J12*(D8-1)+612)/D8	IF(ABS(J12-F12)>1,1,0)	
13	A12+1								(J13*(D8-1)+613)/D8	IF(ABS(J13-F13)>1,1,0)	
14	A13+1								(J14*(D8-1)+614)/D8	IF(ABS(J14-F14)>1,1,0)	
15	A14+1								(J15*(D8-1)+615)/D8	IF(ABS(J15-F15)>1,1,0)	
16	A15+1								(J16*(D8-1)+616)/D8	IF(ABS(J16-F16)>1,1,0)	
17	A16+1								(J17*(D8-1)+617)/D8	IF(ABS(J17-F17)>1,1,0)	
18	A17+1								(J18*(D8-1)+618)/D8	IF(ABS(J18-F18)>1,1,0)	
19	A18+1								(J19*(D8-1)+619)/D8	IF(ABS(J19-F19)>1,1,0)	
20	A19+1								(J20*(D8-1)+620)/D8	IF(ABS(J20-F20)>1,1,0)	
21	A20+1								(J21*(D8-1)+621)/D8	IF(ABS(J21-F21)>1,1,0)	
22	A21+1								(J22*(D8-1)+622)/D8	IF(ABS(J22-F22)>1,1,0)	
23	A22+1								(J23*(D8-1)+623)/D8	IF(ABS(J23-F23)>1,1,0)	
24	A23+1								(J24*(D8-1)+624)/D8	IF(ABS(J24-F24)>1,1,0)	
25	A24+1								(J25*(D8-1)+625)/D8	IF(ABS(J25-F25)>1,1,0)	
26	A25+1								(J26*(D8-1)+626)/D8	IF(ABS(J26-F26)>1,1,0)	
27	A26+1								(J27*(D8-1)+627)/D8	IF(ABS(J27-F27)>1,1,0)	
28	A27+1								(J28*(D8-1)+628)/D8	IF(ABS(J28-F28)>1,1,0)	
29	A28+1								(J29*(D8-1)+629)/D8	IF(ABS(J29-F29)>1,1,0)	
30	A29+1								(J30*(D8-1)+630)/D8	IF(ABS(J30-F30)>1,1,0)	
31	A30+1								(J31*(D8-1)+631)/D8	IF(ABS(J31-F31)>1,1,0)	
32											
33			TOTAL****			SUM(H12:H31)		SUM(I12:I31)			
34						Boarding		Alighting			
35	GLOBAL INDICATORS:										
36	** km /pass =		033/L33								
37	** min/pass =		P33/L33								
38	**ratio v/c =		033/(D8*H4*MAX(E13:E31))								

	L	M	N	O	P	Q	R
1							
2							
3							
4							
5							
6							
7							
8	CUMULATIVE CALCULATIONS						
9	PASSENGERS					SPEEDS	
10	Boarding	Alighting	Occupancy	Passenger km	Passenger min	theoretical	observed
11							
12	L12+H12	M12+I12	L12-M12	##########	##########	##########	##########
13	L13+H13	M13+I13	L13-M13+N12	N12*(E13-E12)	N12*(F13-F12)	(E13-E12)/(F13-F12)*60.	(E13-E12)/(J13-J12)*60.
14	L14+H14	M14+I14	L14-M14+N13	N13*(E14-E13)	N13*(F14-F13)	(E14-E13)/(F14-F13)*60.	(E14-E13)/(J14-J13)*60.
15	L15+H15	M15+I15	L15-M15+N14	N14*(E15-E14)	N14*(F15-F14)	(E15-E14)/(F15-F14)*60.	(E15-E14)/(J15-J14)*60.
16	L16+H16	M16+I16	L16-M16+N15	N15*(E16-E15)	N15*(F16-F15)	(E16-E15)/(F16-F15)*60.	(E16-E15)/(J16-J15)*60.
17	L17+H17	M17+I17	L17-M17+N16	N16*(E17-E16)	N16*(F17-F16)	(E17-E16)/(F17-F16)*60.	(E17-E16)/(J17-J16)*60.
18	L18+H18	M18+I18	L18-M18+N17	N17*(E18-E17)	N17*(F18-F17)	(E18-E17)/(F18-F17)*60.	(E18-E17)/(J18-J17)*60.
19	L19+H19	M19+I19	L19-M19+N18	N18*(E19-E18)	N18*(F19-F18)	(E19-E18)/(F19-F18)*60.	(E19-E18)/(J19-J18)*60.
20	L20+H20	M20+I20	L20-M20+N19	N19*(E20-E19)	N19*(F20-F19)	(E20-E19)/(F20-F19)*60.	(E20-E19)/(J20-J19)*60.
21	L21+H21	M21+I21	L21-M21+N20	N20*(E21-E20)	N20*(F21-F20)	(E21-E20)/(F21-F20)*60.	(E21-E20)/(J21-J20)*60.
22	L22+H22	M22+I22	L22-M22+N21	N21*(E22-E21)	N21*(F22-F21)	(E22-E21)/(F22-F21)*60.	(E22-E21)/(J22-J21)*60.
23	L23+H23	M23+I23	L23-M23+N22	N22*(E23-E22)	N22*(F23-F22)	(E23-E22)/(F23-F22)*60.	(E23-E22)/(J23-J22)*60.
24	L24+H24	M24+I24	L24-M24+N23	N23*(E24-E23)	N23*(F24-F23)	(E24-E23)/(F24-F23)*60.	(E24-E23)/(J24-J23)*60.
25	L25+H25	M25+I25	L25-M25+N24	N24*(E25-E24)	N24*(F25-F24)	(E25-E24)/(F25-F24)*60.	(E25-E24)/(J25-J24)*60.
26	L26+H26	M26+I26	L26-M26+N25	N25*(E26-E25)	N25*(F26-F25)	(E26-E25)/(F26-F25)*60.	(E26-E25)/(J26-J25)*60.
27	L27+H27	M27+I27	L27-M27+N26	N26*(E27-E26)	N26*(F27-F26)	(E27-E26)/(F27-F26)*60.	(E27-E26)/(J27-J26)*60.
28	L28+H28	M28+I28	L28-M28+N27	N27*(E28-E27)	N27*(F28-F27)	(E28-E27)/(F28-F27)*60.	(E28-E27)/(J28-J27)*60.
29	L29+H29	M29+I29	L29-M29+N28	N28*(E29-E28)	N28*(F29-F28)	(E29-E28)/(F29-F28)*60.	(E29-E28)/(J29-J28)*60.
30	L30+H30	M30+I30	L30-M30+N29	N29*(E30-E29)	N29*(F30-F29)	(E30-E29)/(F30-F29)*60.	(E30-E29)/(J30-J29)*60.
31	L31+H31	M31+I31	L31-M31+N30	N30*(E31-E30)	N30*(F31-F30)	(E31-E30)/(F31-F30)*60.	(E31-E30)/(J31-J30)*60.
32							
33	SUM(L12:L31)	SUM(M12:M31)	MAX(N12:N31)	SUM(O12:O31)	SUM(P12:P31)		
34	Boarding	Alighting	Max on board				

FIGURE 3 Formulas stored in basic worksheet.

duced here for explanatory purposes only. The ERROR messages in Figure 2 are normal because the program calculates, with the help of the formula of Figure 3, speeds and global indicators using times and distances, which are presently zero. CALC will produce meaningful values only when numbers are introduced into areas C1 to I20.

To understand the formulas, consider the number of passengers on the bus in column N of Figure 3 at the third bus stop. The number of boarding passengers corresponds to the current contents of cell L14 plus the contents of cell H14, which contains the number of passengers boarding and counted by the observer. Occupancy is calculated in column N as the difference between the number of boarding and alighting passengers plus those who are already in the bus from the preceding stop. The references to the cells can be interpreted as the indices of a matrix. One of the most useful characteristics of CALC is that all indices are automatically changed if a row (i.e., a bus stop) is deleted or inserted, so the worksheet can truly be used for any bus line with any number of stops.

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 times defines the field sheet shown in Figure 4. If separation lines are inserted, this sheet can be used directly on the bus (Figure 5).

PUBLIC TRANSPORTATION USAGE				R. Chapleau				
-----example of compilation-----								
LINE:I	DATE:		TEMP:		CAP.:	0		
51 I	DAY:							
						run =		
TOTAL NUMBER						dir =		
OF RUNS =		1	DIST.	TIME		start=		
No.	BUS		(km)	(min.)		PASSENGERS		
	STOP			theor.	obs.	ON	OFF	
1	ST-JOHN		0	0				
2	HALIFAX		.82	2.5				
3	SIDNEY		1.79	6.1				
4	CHARLOTTE		2.45	8.7				
5	SOURIS		3.6	11.6				
6	MONCTON		4.82	14.3				
7	FREDERICTON		5.74	17.9				
8	QUEBEC		7	21.1				
9	SHERBROOKE		7.95	23.8				
10	MONTREAL		8.81	26.5				
11	OTTAWA		10.42	29.7				
12	TORONTO		11.36	32.1				
13	LONDON		12.4	34.2				
14	WINNIPEG		13.46	38.3				
15	REGINA		14.1	41.6				
16	EDMONTON		15.08	45.2				
17	CALGARY		16.37	48.7				
18	VICTORIA		16.88	52.6				
19	VANCOUVER		17.55	54.9				
20	YELLOWKNIFE		18	60				

FIGURE 4 Field sheed 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, BA1, BA2, and BA3, 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 BA1, for example,

PUBLIC TRANSPORTATION USAGE				R. Chapleau				
-----example of compilation-----								
LINE:I	DATE:		TEMP:		CAP.:	75		
51 I	DAY:							
						run =		
TOTAL NUMBER						dir =		
OF RUNS $$						start=		
No.	BUS		DIST.	TIME		PASSENGERS		
	STOP		(km)	(min)		ON	OFF	
				theor.	obs.			
1	ST-JOHN		.00	0				
2	HALIFAX		.82	2.5				
3	SIDNEY		1.79	6.1				
4	CHARLOTTE		2.45	8.7				
5	SOURIS		3.60	11.6				
6	MONCTON		4.82	14.3				
7	FREDERICTON		5.74	17.9				
8	QUEBEC		7.00	21.1				
9	SHERBROOKE		7.95	23.8				
10	MONTREAL		8.81	26.5				
11	OTTAWA		10.42	29.7				
12	TORONTO		11.36	32.1				
13	LONDON		12.40	34.2				
14	WINNIPEG		13.46	38.3				
15	REGINA		14.10	41.6				
16	EDMONTON		15.08	45.2				
17	CALGARY		16.37	48.7				
18	VICTORIA		16.88	52.6				
19	VANCOUVER		17.55	54.9				
20	YELLOWKNIFE		18.00	60				

FIGURE 5 Field sheet used on a bus.

the basic worksheet (Figure 2) is first loaded from disk file into the memory of the computer and then the contents of disk file BA1 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 BA2 and BA3 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

PUBLIC TRANSPORTATION USAGE R. Chapleau
-----example of compilation-----

LINE:I DATE:150683 TEMP: clear CAP.: 75
51 I DAY:monday

run = BA1, dir =WEST, start=07h00

TOTAL NUMBER OF RUNS = 1

No.	BUS STOP	DIST. (km)	TIME (min.) theor.	TIME (min.) obs.	PASSENGERS ON	PASSENGERS OFF
1	ST-JOHN	0	0	0	10	0
2	HALIFAX	.82	2.5	3	5	2
3	SIDNEY	1.79	6.1	6	5	2
4	CHARLOTTE	2.45	8.7	9	3	3
5	SOURIS	3.6	11.6	12	4	0
6	MONCTON	4.82	14.3	15	2	6
7	FREDERICTON	5.74	17.9	18	0	1
8	QUEBEC	7	21.1	21	7	2
9	SHERBROOKE	7.95	23.8	24	12	0
10	MONTREAL	8.81	26.5	27	8	3
11	OTTAWA	10.42	29.7	30	5	2
12	TORONTO	11.36	32.1	33	4	0
13	LONDON	12.4	34.2	36	1	1
14	WINNIPEG	13.46	38.3	39	6	0
15	REGINA	14.1	41.6	42	8	2
16	EDMONTON	15.08	45.2	45	0	0
17	CALGARY	16.37	48.7	48	0	4
18	VICTORIA	16.88	52.6	51	7	0
19	VANCOUVER	17.55	54.9	54	1	33
20	YELLOWKNIFE	18	60	60	0	27
					88	88

PUBLIC TRANSPORTATION USAGE R. Chapleau
-----example of compilation-----

LINE:I DATE:150683 TEMP: clear CAP.: 75
51 I DAY:monday

run = BA2, dir =WEST, start=07h15

TOTAL NUMBER OF RUNS = 2

No.	BUS STOP	DIST. (km)	TIME (min.) theor.	TIME (min.) obs.	PASSENGERS ON	PASSENGERS OFF
1	ST-JOHN	0	0	0	8	0
2	HALIFAX	.82	2.5	2	3	1
3	SIDNEY	1.79	6.1	5	5	3
4	CHARLOTTE	2.45	8.7	10	4	2
5	SOURIS	3.6	11.6	12	3	1
6	MONCTON	4.82	14.3	15.5	0	4
7	FREDERICTON	5.74	17.9	19.2	1	0
8	QUEBEC	7	21.1	21.5	8	4
9	SHERBROOKE	7.95	23.8	24.6	16	2
10	MONTREAL	8.81	26.5	27	5	5
11	OTTAWA	10.42	29.7	30.5	4	4
12	TORONTO	11.36	32.1	33	3	0
13	LONDON	12.4	34.2	35	2	3
14	WINNIPEG	13.46	38.3	39.2	8	5
15	REGINA	14.1	41.6	43	4	3
16	EDMONTON	15.08	45.2	46	0	5
17	CALGARY	16.37	48.7	49.5	0	8
18	VICTORIA	16.88	52.6	54	2	5
19	VANCOUVER	17.55	54.9	57	2	21
20	YELLOWKNIFE	18	60	61	0	2
					78	78

PUBLIC TRANSPORTATION USAGE R. Chapleau
-----example of compilation-----

LINE:I DATE:150683 TEMP: clear CAP.: 75
51 I DAY:monday

run = BA3, dir =WEST, start=07h30

TOTAL NUMBER OF RUNS = 3

No.	BUS STOP	DIST. (km)	TIME (min.) theor.	TIME (min.) obs.	PASSENGERS ON	PASSENGERS OFF
1	ST-JOHN	0	0	0	4	0
2	HALIFAX	.82	2.5	3.1	6	0
3	SIDNEY	1.79	6.1	6.5	5	0
4	CHARLOTTE	2.45	8.7	9.2	1	4
5	SOURIS	3.6	11.6	11.8	7	2
6	MONCTON	4.82	14.3	14.4	1	0
7	FREDERICTON	5.74	17.9	17.7	0	0
8	QUEBEC	7	21.1	21	4	3
9	SHERBROOKE	7.95	23.8	23	11	4
10	MONTREAL	8.81	26.5	25	8	2
11	OTTAWA	10.42	29.7	29	8	3
12	TORONTO	11.36	32.1	32.4	2	0
13	LONDON	12.4	34.2	35	0	0
14	WINNIPEG	13.46	38.3	39	4	4
15	REGINA	14.1	41.6	42	0	3
16	EDMONTON	15.08	45.2	45	1	6
17	CALGARY	16.37	48.7	48.8	1	9
18	VICTORIA	16.88	52.6	55	0	4
19	VANCOUVER	17.55	54.9	58	0	18
20	YELLOWKNIFE	18	60	62	0	1
					63	63

FIGURE 6 Observations of three bus runs on Line 51.

PUBLIC TRANSPORTATION USAGE R. Chapleau
-----example of compilation-----

LINE:I DATE:150683 TEMP: clear CAP.: 75
51 I DAY:monday

run = BA1, dir =WEST, start=07h00

TOTAL NUMBER OF RUNS = 1

No.	BUS STOP	DIST. (km)	TIME (min.) theor.	TIME (min.) obs.	PASSENGERS ON	PASSENGERS OFF	Tmean (min)		CUMULATIVE PASSENGERS ON	CUMULATIVE PASSENGERS OFF	IN	pass km	pass min	SPEED theor.	SPEED obs.
1	ST-JOHN	0	0	0	10	0	0		10	0	10	******	******	******	******
2	HALIFAX	.82	2.5	3	5	2	3		5	2	13	8.2	25	19.68	16.4
3	SIDNEY	1.79	6.1	6	5	2	6		5	2	16	12.61	46.8	16.17	19.4
4	CHARLOTTE	2.45	8.7	9	3	3	9		3	3	16	10.56	41.6	15.23	13.2
5	SOURIS	3.6	11.6	12	4	0	12		4	0	20	18.4	46.4	23.79	23
6	MONCTON	4.82	14.3	15	2	6	15		2	6	16	24.4	54	27.11	24.4
7	FREDERICTON	5.74	17.9	18	0	1	18		0	1	15	14.72	57.6	15.33	18.4
8	QUEBEC	7	21.1	21	7	2	21		7	2	20	18.9	48	23.63	25.2
9	SHERBROOKE	7.95	23.8	24	12	0	24		12	0	32	19	54	21.11	19
10	MONTREAL	8.81	26.5	27	8	3	27		8	3	37	27.52	86.4	19.11	17.2
11	OTTAWA	10.42	29.7	30	5	2	30		5	2	40	59.57	118.4	30.19	32.2
12	TORONTO	11.36	32.1	33	4	0	33		4	0	44	37.6	96	23.5	18.8
13	LONDON	12.4	34.2	36	1	1	36	*	1	1	44	45.76	92.4	29.71	20.8
14	WINNIPEG	13.46	38.3	39	6	0	39		6	0	50	46.64	180.4	15.51	21.2
15	REGINA	14.1	41.6	42	8	2	42		8	2	56	32	165	11.64	12.8
16	EDMONTON	15.08	45.2	45	0	0	45		0	0	56	54.88	201.6	16.33	19.6
17	CALGARY	16.37	48.7	48	0	4	48		0	4	52	72.24	196	22.11	25.8
18	VICTORIA	16.88	52.6	51	7	0	51	*	7	0	59	26.52	202.8	7.846	10.2
19	VANCOUVER	17.55	54.9	54	1	33	54		1	33	27	39.53	135.7	17.48	13.4
20	YELLOWKNIFE	18	60	60	0	27	60		0	27	0	12.15	137.7	5.294	4.5
	TOTAL ****				88	88			88	88	59	581.2	1986.		
					on	off			ON	OFF	IN max				

GLOBAL INDICATORS:
** km /pass = 6.605
** min/pass = 22.57
**ratio v/c = .4305

```
No. BUS      ON     10   20   30   40   50   60   70   80   90
    STOP  BOARD
----------------------------------------------------------------
    1ST-JOH   10 *****
    2HALIFA   13 ******
    3SIDNEY   16 ********
    4CHARLO   16 ********
    5SOURIS   20 **********
    6MONCTO   16 ********
    7FREDER   15 *******
    8QUEBEC   20 **********
    9SHERBR   32 ****************
   10MONTRE   37 ******************
   11OTTAWA   40 ********************
   12TORONT   44 **********************
   13LONDON   44 **********************
   14WINNIP   50 *************************
   15REGINA   56 ****************************
   16EDMONT   56 ****************************
   17CALGAR   52 **************************
   18VICTOR   59 *****************************
   19VANCOU   27 *************
   20YELLOW    0
----------------------------------------------------------------
```

FIGURE 7 Report of bus run BA1 on Line 51.

```
  I A I  I C II D II E II F II G II H II I II J I  I L II M II N II O II P II Q II R I
 1|PUBLIC TRANSPORTATION USAGE     R. Chapleau
 2|-----example of compilation-----
 3|--------------------------------------------------------------------------------------
 4| LINE:I  DATE:150683 TEMP: clear CAP.:     75
 5|  51  I    DAY:monday
 6|----------------------------------- run = BA3 ----------------------------------------
 7|TOTAL NUMBER                         dir =WEST
 8|  OF RUNS  =        3 DIST.   TIME   start=07h30          C U M U L A T I V E
 9|   No.    BUS         (km)   (min.)     PASSENGERS Tmean      PASSENGERS       pass pass    SPEED
10|          STOP             theor. obs.   ON   OFF  (min)    ON    OFF    IN    km   min theor. obs.
11|--------------------------------------------------------------------------------------
12|     1  ST-JOHN          0     0     0    4     0     0     22     0    22************************
13|     2  HALIFAX        .82   2.5   3.1    6     0   2.7     14     3    33 18.04    55 19.68 18.22
14|     3  SIDNEY        1.79   6.1   6.5    5     0 5.833     15     5    43 32.01 118.8 16.17 18.57
15|     4  CHARLOTTE     2.45   8.7   9.2    1     4   9.4      8     9    42 28.38 111.8 15.23 11.10
16|     5  SOURIS         3.6  11.6  11.8    7     2 11.93     14     3    53  48.3 121.8 23.79 27.24
17|     6  MONCTON       4.82  14.3  14.4    1     0 14.97      3    10    46 64.66 143.1 27.11 24.13
18|     7  FREDERICTON   5.74  17.9  17.7    0     0  18.3      1     1    46 42.32 165.6 15.33 16.56
19|     8  QUEBEC           7  21.1    21    4     3 21.17     19     9    56 57.96 147.2 23.63 26.37
20|     9  SHERBROOKE    7.95  23.8    23   11     4 23.87     39     6    89  53.2 151.2 21.11 21.11
21|    10  MONTREAL      8.81  26.5    25    8     2 26.33     21    10   100 76.54 240.3 19.11 20.92
22|    11  OTTAWA       10.42  29.7    29    8     3 29.83     17     9   108   161   320 30.19  27.6
23|    12  TORONTO      11.36  32.1  32.4    2     0  32.8      9     0   117 101.5 259.2  23.5 19.01
24|    13  LONDON        12.4  34.2    35    0     0 35.33 *    3     4   116 121.7 245.7 29.71 24.63
25|    14  WINNIPEG     13.46  38.3    39    4     4 39.07     18     9   125 123.0 475.6 15.51 17.04
26|    15  REGINA        14.1  41.6    42    0     3 42.33     12     8   129    80 412.5 11.64 11.76
27|    16  EDMONTON     15.08  45.2    45    1     6 45.33      1    11   119 126.4 464.4 16.33  19.6
28|    17  CALGARY      16.37  48.7  48.8    1     9 48.77      1    21    99 153.5 416.5 22.11 22.54
29|    18  VICTORIA     16.88  52.6    55    0     4 53.33      9     9    99 50.49 386.1 7.846 6.701
30|    19  VANCOUVER    17.55  54.9    58    0    18 56.33 *    3    72    30 66.33 227.7 17.48  13.4
31|    20  YELLOWKNIFE     18    60    62    0     1    61      0    30     0  13.5   153 5.294 5.786
32|                   -------------------------------------------------------------------
33|                   T O T A L * * * *     63    63            229   229   129 1419. 4616.
34|                                         on    off            ON   OFF IN max
35|GLOBAL INDICATORS:
36|        ** km /pass =  6.196
37|        ** min/pass =  20.16
38|        **ratio v/c =  .3503

  I S II  T II  U II                       V                          I
 9|   No. BUS     ON     10   20   30   40   50   60   70   80   90
10|       STOP BOARD
11|--------------------------------------------------------------------
12|      1ST-JOH 7.333 ***
13|      2HALIFA    11 *****
14|      3SIDNEY 14.33 *******
15|      4CHARLO    14 *******
16|      5SOURIS 17.67 ********
17|      6MONCTO 15.33 *******
18|      7FREDER 15.33 *******
19|      8QUEBEC 18.67 *********
20|      9SHERBR 29.67 **************
21|     10MONTRE 33.33 ****************
22|     11OTTAWA    36 ******************
23|     12TORONT    39 *******************
24|     13LONDON 38.67 *******************
25|     14WINNIP 41.67 ********************
26|     15REGINA    43 *********************
27|     16EDMONT 39.67 *******************
28|     17CALGAR    33 ****************
29|     18VICTOR    33 ****************
30|     19VANCOU    10 *****
31|     20YELLOW     0
32|--------------------------------------------------------------------
```

FIGURE 8 Report giving averages for three bus runs during peak hour.

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.

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