

## A POCKET CALCULATOR PROGRAM TO SORT DATA

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**Abstract**—A program is presented for use with a TI59 calculator in sorting up to 98 data.

TI59 calculator      Sorting

Ranking of biological data is an often required procedure. Ranking of a small number of data is readily performed by paper and pencil, but when the number of data increases it is desirable to leave the ranking to computers.

The Texas Instruments TI59 calculator with a statistical module is able to perform ranking as part of non parametrical statistical procedures, however, the maximal number of data it can sort is 60. A shell sorting programme, able to sort 99 data in about  $9\frac{1}{2}$  min is commercially available in the TI Math/Utilities Rom. A highly sophisticated fast shell sorting program which takes advantage of the hierachial registers of the TI-59 [1], and a program to alphabetic sort has been demonstrated [2].

The sorting program presented here, written for the TI59, is able to sort 98 data. This number is the maximum number the TI59 is able to sort by simple procedure since there are 100 registers and two are used for counters. The method used for ranking is straight forward. If  $N$  data are fed into the calculator it firstly finds the number with the highest numerical value and stores it in register  $N$ . Among the remaining  $N - 1$  data it then finds the one with the highest value and stores it in register  $N - 1$  and so on (steps 040-093).

This method uses two counters and is fastest when the number of data is small.

The computation time of a number of data can be read from Fig. 1. The speed of sorting is optimal, i.e. the program was first written by the use of labels; this program required 82 min to sort 98 data. Then the program was changed to only contain GOTO-statement and the time was reduced to 52 min for 98 data.

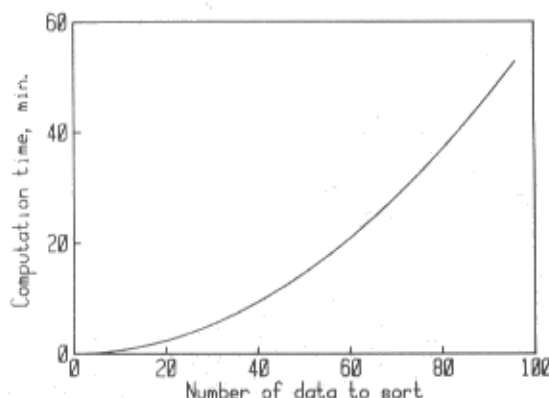


Fig. 1. Relation between the number of data and the time in minutes required to sort the data. The curve is based on the number of comparisons which for  $N$  numbers is  $1 + 2 + 3 + \dots + N$ .

Table 1.

000	69	DP	040	76	LBL	080	00	0	120	01	1			
001	20	20	041	11	A	081	49	49	121	03	3			
002	99	PRT	042	43	RCL	082	73	73	122	69	DP			
003	72	ST*	043	00	00	083	00	0	123	01	01			
004	00	00	044	42	STD	084	22	INV	124	03	3			
005	09	9	045	99	99	085	77	GE	125	05	5			
006	08	8	046	51	GTD	086	00	00	126	06	6			
007	32	XIT	047	00	00	087	72	72	127	03	3			
008	43	RCL	048	69	69	088	32	XIT	128	03	3			
009	00	00	049	43	RCL	089	63	EX*	129	06	6			
010	77	GE	050	99	99	090	00	00	130	69	DP			
011	11	A	051	75	-	091	61	GTD	131	02	02			
012	68	NOP	052	01	1	092	00	00	132	69	DP			
013	68	NOP	053	95	-	093	72	72	133	05	05			
014	91	R/S	054	42	STD	094	76	LBL	134	47	CHS			
015	81	RST	055	99	99	095	15	E	135	29	CP			
016	76	LBL	056	42	STD	096	98	ADV	136	25	CLR			
017	10	E*	057	00	00	097	69	DP	137	98	ADV			
018	00	0	058	29	CP	098	00	00	138	91	R/S			
019	72	ST*	059	22	INV	099	03	3	139	81	RST			
020	00	00	060	67	EQ	100	06	6	140	76	LBL			
021	01	1	061	00	00	101	03	3	141	13	C			
022	94	+/-	062	46	46	102	02	2	142	01	1			
023	44	SUM	063	98	ADV	103	03	3	143	42	STD			
024	00	00	064	98	ADV	104	05	5	144	00	00			
025	69	DP	065	01	1	105	03	3	145	43	RCL			
026	00	00	066	22	INV	106	07	7	146	00	00			
027	01	1	067	90	LST	107	69	DP	147	32	XIT			
028	07	7	068	91	R/S	108	02	02	148	73	RC*			
029	03	3	069	73	RC*	109	69	DP	149	00	00			
030	05	5	070	00	00	110	05	05	150	91	R/S			
031	03	3	071	32	XIT	111	98	ADV	151	01	1			
032	05	5	072	97	DSZ	112	69	DP	152	44	SUM			
033	69	DP	073	00	00	113	00	00	153	00	00			
034	04	04	074	00	00	114	01	1	154	61	GTD			
035	69	DP	075	82	82	115	06	6	155	01	01			
036	05	05	076	32	XIT	116	01	1	156	45	45			
037	25	CLR	077	72	ST*	117	03	3	157	00	0			
038	91	R/S	078	99	99	118	03	3	158	00	0			
039	81	RST	079	61	GTD	119	07	7	159	00	0			

The program is given in Table 1. Participation, initializing of registers and printing of instructions when the PC 100C is connected are in steps 096-140. The data are read and

Table 2. Instructions to the user

Procedure	Enter	Press	Display	Printer
Load program				
Initialize		E	0	SORT
Data entry	1. DATA	R/S	1 <sup>1</sup>	DATA R/S
	2. DATA	R/S	2	1. DATA
	—	—	—	2. DATA
Data correction <sup>2</sup>	—	E	0	ERR
	—	—	—	—
	N.DATA	R/S	N <sup>3</sup>	N.DATA
Sort		A		
Listing of sorted data <sup>4</sup>				DATA 01
				DATA 02
				— —
				DATA N
				— —
				0 98
				0 99
Display sorted data		C	DATA	
	x $\frac{1}{2}$ t	R/S	RANK	
	—	—	NEXT DATA	
	x $\frac{1}{2}$ t	—	RANK	
	—	—	—	

<sup>1</sup> The data can be displayed by changing line 012 and 013 to RC\*00

<sup>2</sup> Deletes last data, unless No. 98

<sup>3</sup> Branches to sorting procedure when N data is read

<sup>4</sup> Only when PC 100C is connected.

printed by the loop in steps 000–015, and the last datum is deleted by the subroutine 'E' (016–039). A print of the sorted data and their rank is performed in steps 065–067, and displayed by the subroutine C (143–158).

User instructions are given in Table 2 together with a print of six data.

It should be noted that the program gives the highest rank to the first of several identical data. If the sorting is used for transformation of the data for non parametrical statistical analysis, an appropriate correction for ties should be performed [3] or the rank value should be assigned at random.

### SUMMARY

The TI59 program presented is a sorting procedure which utilizes all the register capacity of the calculator. The time to sort 98 data is 52 min. The program is able to print instructions, input data, deletion of data and a list of the ranked data and their rank on a PC 100C printer, or can be used without the printer.

### REFERENCES

1. Editor, TI PPC 52-notes V3N2 4, PPC Publications, P.O. Box 1421, Largo, FL 33540.
2. R. Snow, TI PPC 52-notes V5N2 6, PPC Publications, P.O. Box 1421, Largo, FL 33540.
3. S. Siegel, *Nonparametric Statistics for the Behavioral Sciences*. McGraw-Hill-Kogakusha, Tokyo (1956).

**About the Author**—HENRIK E. POULSEN was born in Aalborg, Denmark, in 1948. He studied medicine at Copenhagen University. He has been working on quantitation of liver functions for some years. At present he is a research fellow at the division of hepatology, Rigshospitalet, Copenhagen.