EUROPE 5 2 1 0 5 **Program Description I**

Program Title LINEAR SYSTEMS

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Program Description, Equations, Variables

This program solves linear systems n.n with real coefficients for n=2,3,...,10, using n data-cards. Coefficients have to be keyed in only once. First key in n, using LBLA. Next, on seeing displayed a number i with a program stop, key in the coefficients of the i-th equation, one by one. On seeing a number i in -x- mode, followed by Crd, use data-card i, one side only. On seeing a number i in pause-mode, again use data-card i, one side only. Never use the second side of a data-card, even when HP asks for a second side (in that case, just press RS or RS RS). After some time (having used data-cards n^2+n-4 times), you'll find 0, meaning end of calculation. Just press RS to see solution (repeatable). Furthermore, to find out how good your solution is, key in coefficients of any equation, one by one, using LBL E and RS, and find value of right member of that equation (in DSP9).

Operating Limits and Warnings

Your system is supposed to have one solution only. The usual precautions have to be made to avoid divisions by zero (changing the order of the equations or the unknowns may help!)
You should number your data-cards, before starting!

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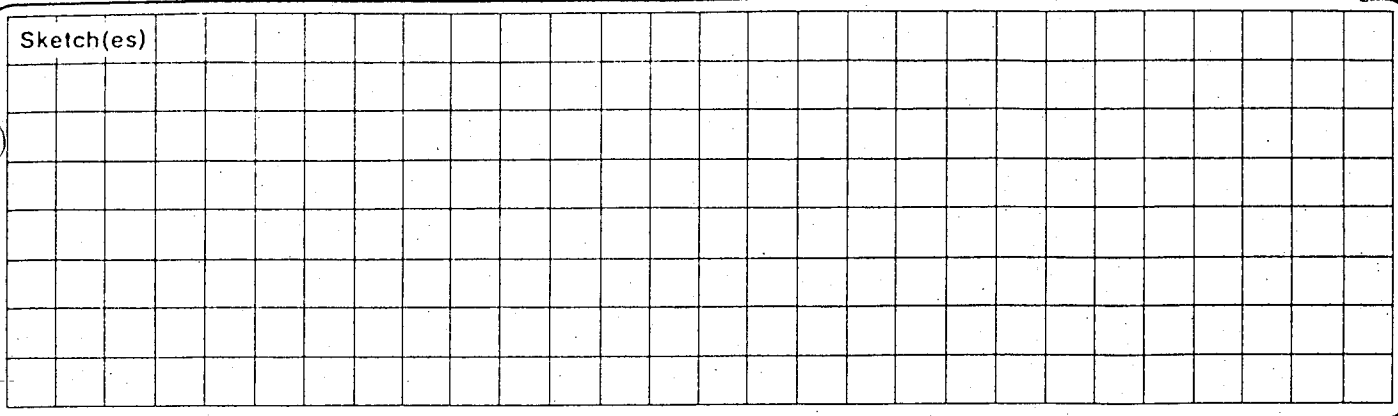
Sketch(es)



Sample Problem(s)

To get acquainted with the idea, solve the "small" system

$$\begin{cases} \pi x + 2y + z = 10 \\ x + 3y + 2z = 9 \\ 2x + y + 3z = 8 \end{cases}$$

Press 3 A and find 1 (first equation). Key in

π RS 2 RS 1 RS 10 RS, find 1 Crd, use data-card 1, find 2. Key in

1 RS 3 RS 2 RS 9 RS, find 2 Crd, use data-card 2, see Crd, ignore this by pressing RS RS, find 3. Key in

2 RS 1 RS 3 RS 8 RS, find 3 Crd, use data-card 3, see Crd, press RS RS, find 2 pause, use data-card 2, see Crd, press RS, see 2 Crd, use card 2, see Crd, press RS RS,

find 3 pause, use card 3, see Crd, press RS,

find 2 pause, use card 2, see Crd, press RS,

find 1 pause, use card 1, find 0.

Solution(s)

Press RS and find x=1.737651615
y=1.819664516
z=0.901677418, then 0 (repeatable).

Test solution: key in

π E 2 RS 1 RS find 9.999 999 999
1 E 3 RS 2 RS find 8.999 999 999
2 E 1 RS 3 RS find 8.000 000 001

Reference(s)

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STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program			
2	Initialize by keying in size n	n	A	1
3	On seeing i (when program stopped), key in coefficients of i-th equation, one by one, right member included	coeff.	RS	ignore
		...		
		coeff.	RS	
4	On seeing i (in -x- mode), followed by Crd, use data-card i, one side only.			
	If Crd is shown a second time, ignore it and press RS RS.			
5	On seeing i (in pause-mode), use data-card i during one of the pauses, one side only. If Crd is shown, ignore this by pressing RS.			
6	Having used data-cards n^2+n-4 times, find 0			0
7	Press RS to see solution (repeatable)		RS	x_1
				x_2
				...
				x_n
				0
8	To test how good your solution is, key in coefficients of left member of any equation, one by one, and find right member:	coeff.	E	ignore
		coeff	RS	ignore
		...		
		coeff	RS	right member

STEP	KEY ENTRY	KEY CODE	COMMENTS
01	*LBLA		Key in size n
	SF1		
	CLRG		
	DSZ		
	CLRG		
	RCLC		
	1		
	STOD		
	RS		Key in a_{11}
10	STOC		
	*LBL1		
	RS		Key in next a_{1j}
	RCLC		
	:		
	STOi		$\frac{a_{1j}}{a_{11}}$
	ISZ		
	RCI		
	RCLD		
	x≠y?		$j+1 \neq n$?
20	GTO1		
	RCLD		
	-x-		card 1 asked for
	DATA		
	PS		equation 1 put in Sec. Reg.
	*LBL2		
	0		
	STI		
	RCLC		
	RCLD		
30	1		
	+		
	STOD		next equation number i
	x>y?		$i > n$?
	GTO0		
	RS		Key in a_{i1}
	STOC		
	*LBL3		
	RS		Key in next a_{ij}
	RCLC		
40	PS		
	RCLi		
	PS		
	x		
	-		
	STOi		$a_{ij} - a_{i1} a_{j+1}$
	ISZ		
	RCI		
	RCLC		
	x≠y?		$j+1 \neq n$?
50	GTO3		
	RCLD		
	-x-		card i asked for
	DATA		
	GTO2		
	*LBL0		
	1		

STEP	KEY ENTRY	KEY CODE	COMMENTS
	STOD		i = 1
	*LBL4		
	0		
060	STOC		Δi = 0
	RCLD		
	1		
	-		
	RCLD		
	1		
	+		
	STOD		
	x=y?		i = n-1?
	SF1		
070	-		
	2		
	+		
	STOB		k = n-i+1
	STI		
	RCLD		
	D		card i to be loaded into Reg
	RCLC		
	*LBL5		
	STO:i		first coeff. reduced to unity
080	DSZ		
	GTO5		
	B		coefficients move one place "to the left"
	-x-		card i asked for
	DATA		
	PS		leading equation in Sec Reg.
	*LBL6		
	RCLB		
	RCLD		
	RCLC		
090	1		
	+		
	STOC		Δi → Δi+1
	+		
	x>y?		i+Δi > n?
	GTO4		
	D		card i+Δi to be loaded
	*LBL7		
	RCLC		
	DSZ		
100	SPACE		
	PS		
	RCLi		
	PS		
	ISZ		
	x		
	STO-i		first coeff. reduced to zero
	DSZ		
	GTO7		
	B		coefficients move one place "to the left"
110	R?1		end of reduction?
	GTO0		
	RCLC		

REGISTERS

	1	2	3 coefficients of one equation	4	5	6	7	8	9 →
0	S1	S2	S3 coefficients of one equation	S4	S5	S6	S7	S8	S9 →

	B	C	D	E	I
	k = n-i+1 later i = n-i	leading coefficient also Δi	equation number 1	n	used

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STEP	KEY ENTRY	KEY CODE	COMMENTS
	+		
	-x-		card i+Δi asked for
	DSZ		
	GTO5		
	*LBL0		
	RCL1		
	RCL0		
120	:		
	GTO0		last equation solved !
	PS		solution in Sec. Reg.
	*LBL8		
	RCL2		
	RCL0		
	-		
	STO8		k=n-i
	STI		
	RCL0		
130	D		card i to be loaded
	0		
	STI		
	*LBL0		
	RCLi		
	RCL8		
	RCI		
	-		
	1		
	-		
140	x==I		== means ↻
	x==y		
	PS		
	RCLi		
	PS		
	x		
	x==y		
	x==I		
	x==y		
	RCL8		
150	x==I		
	x==y		
	STO-i		equation i solved
	x==y		
	x==I		
	ISZ		
	RCI		
	RCL8		
	x>y?		
	GTO9		
160	RCLi		
	PS		
	STOi		solution in Sec. Reg.
	PS		
	RCL0		
	1		
	-		
	STO0		
	x≠0?		i ≠ 0 ?

STEP	KEY ENTRY	KEY CODE	COMMENTS
	GTO6		
170	RS		solution in Prim. Reg.
	*LBL6		
	RCL0		
	STI		
	DSZ		
	0		
	RCL0		
	RS		first 0 (ready !)
	DSZ0		
	*LBL0		
180	RCLi		
	-x-		solution shown
	DSZ		
	GTOC		
	RCL0		
	-x-		last part of solution
	GTOc		
	*LBL0		
	CF5		loading subroutine
	MERGE		
190	PAUSE		
	R?3		
	RTN		
	GTOD		
	*LBLB		
	ISZ		
	RCLi		moving routine
	DSZ		
	SPACE		
	STOi		
200	ISZ		
	RCI		
	RCLB		
	x>y?		
	GTO5		
	RCLD		
	RTN		
	*LBLD		
	RCLi		
	x		testing routine
210	+		
	RS		
	DSZ		
	GTOE		
	RCL0		
	x		
	+		
	DSZ9		
	-x-		right member shown
	GTOc		
220			

LABELS

A start (n)	B used	C used	D used	E start	0
a	b	c used	d	e	1 used
0 used	1 used	2 used	3 used	4 used	2
5 used	6 used	7 used	8 used	9 used	3 used

FLAGS

	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

SET STATUS

TRIG	DISP
DEG ☒	FIX ☒
GRAD ☐	SCI ☐
RAD ☐	ENG ☐
	n ____