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PROGRAM DESCRIPTION I

Program Title STRAIGHT LINE FORCED THRU ANY POINT

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Address

City **State/Country** **Zip Code**

Program Description, Equations, Variables This program calculates the bearing of a least squares fit straight line forced through any given point. Predictions of new E' and N' on that line may be made from values of N and E.

Coordinate pairs (N,E) may be added or deleted at any time.

The azimuth of any line is: ATAN (1 / slope)

The derivation for the slope of a line forced through the origin is: $(y = bx)$

(i) $SS = \Sigma (y_i - bx_i)^2$ sum of squares of deviations

(ii) $SS = \Sigma y_i^2 - 2b\Sigma x_i y_i + b^2 \Sigma x_i^2$ of observed from calculated y_i's

(iii) $\partial SS / \partial b = 0$ minimize SS by setting partial derivative = 0 holding b = const

(iv) $0 = -2\Sigma x_i y_i + 2b \Sigma x_i^2$ differentiate

(v) $b = \Sigma x_i y_i / \Sigma x_i^2$ slope

To force a line through any point, the origin (0,0) is shifted to that point and the summations are then made.

Necessary Accessories

Operating Limits and Warnings The farther away a point is from the held point, the more weight it is given, as in normal linear regression (due to the ~~multiplication of X & Y and the squaring of X~~).

Be sure all points are close to a given line or they will seriously affect the bearing (see sample problem)

Reference(s)

NOTE: North is Y East is X

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PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired) see page 3 of 6 for sketch

Given the following points, force a straight line through

(N 460792.951, E 706393.874)

N	460985.727	461283.989	461677.934	462052.108	462463.712
E	706362.528	706321.444	706258.935	706199.674	706131.283

Compute the bearing of the line and make predictions of E' for N 462000 and N' for E 706200

USER XEQ SIZE 017 FIX 3

SOLUTION:

Input	Function	Display	
XEQ "FORCE"			
N↑E HELD ?			
460,792.951			
ENTER↑			
706,393.874			
RUN			
N↑E		XEQ C	
460,985.727	N_1	S 8.4936 E	bearing
ENTER↑		PREDICTIONS:	
706,362.528	E_1	460,792.951	
RUN		0 XEQ D	yes, it was held
N↑E		E: 706,393.8	
461,283.989	N_2	74	
ENTER↑			
706,321.444	E_2	462,000.000	N → E'
RUN		XEQ D	
N↑E		E: 706,206.4	
461,677.934	N_3	37	
ENTER↑			
706,258.935	E_3	706,200.000	E → N'
RUN		XEQ E	
N↑E		N: 462,041.4	
462,052.108	N_4	51	
ENTER↑			
706,199.674	E_4		
RUN			
N↑E			
462,463.712	N_5		
ENTER↑			
706,131.283	E_5		
RUN			
N↑E			

XEQ A

N↑E

462,500.000

0 ENTER↑

706,150.000

0 RUN

N↑E

XEQ C

S 8.3549 E bearing

PREDICTIONS

462,000.000

0 XEQ D

E: 706,211.389

706,200.000

XEQ E

N: 462,075.330

462,500.000

ENTER↑

706,150.000

XEQ B delete point

N↑E

XEQ C

S 8.4936 E bearing

PREDICTIONS

462,000.000

0 XEQ D

E: 706,206.437

706,200.000

XEQ E

N: 462,041.451

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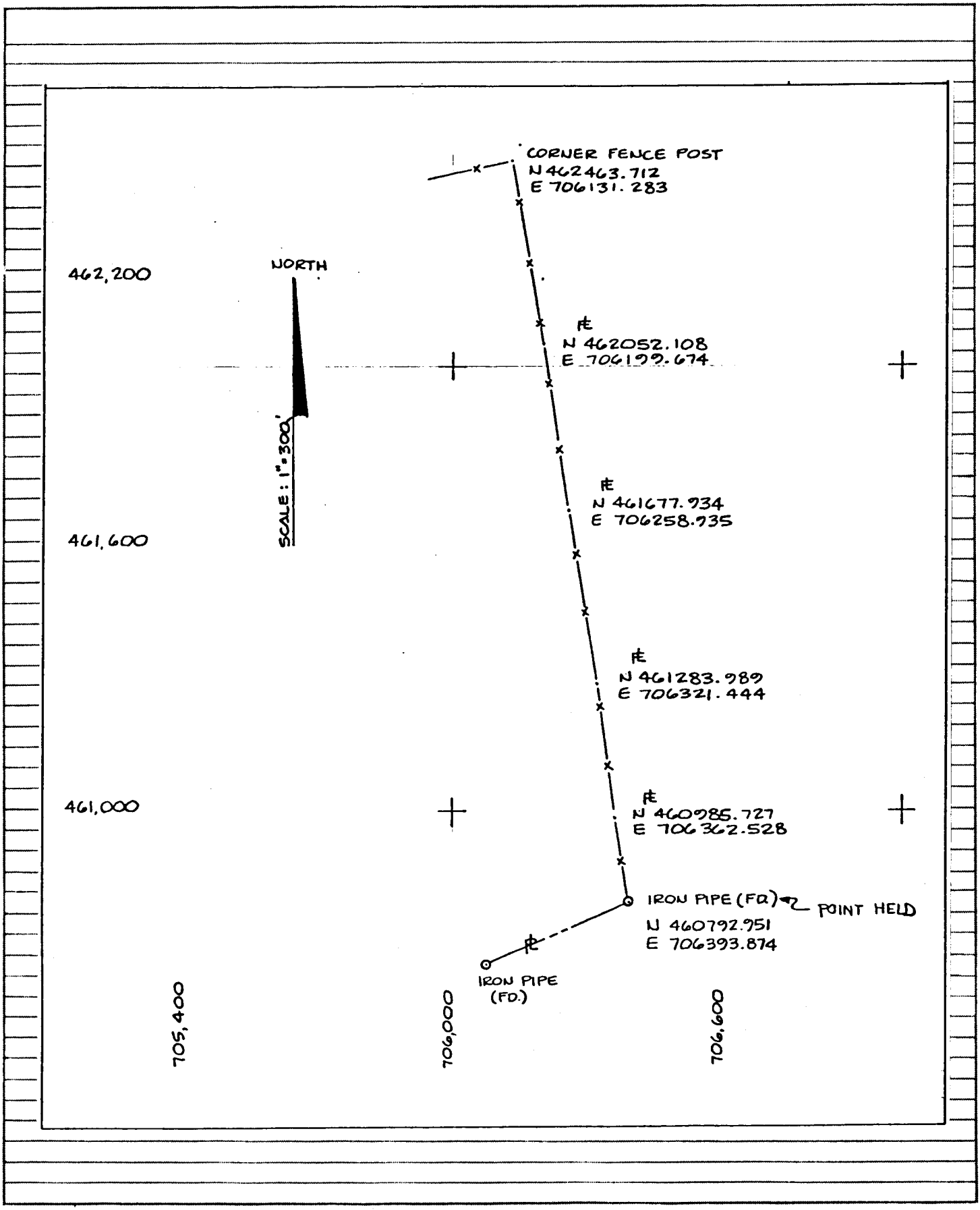
(CONTINUATION PAGE)



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USER INSTRUCTIONS

SIZE: (HP-41C) 017

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter program, check size, USER mode			
2	Begin program		XEQ "FORCE"	N↑E HELD?
3	Enter N & E to be held	N	Ent↑	
		E	R/S	N↑E
4	Enter coordinate pairs	N_i	Ent↑	
		E_i	R/S	N↑E
	repeat step 4 as needed			
5	Compute bearing		C	N/S bearing E
6	Given N predict E' on line	N	D	E: easting
7	Given E predict N' on line	E	E	N: northing
8	to add more coordinate pairs		A	N↑E
	repeat step 4			
9	to delete coordinate pairs	N	Ent↑	
		E	B	N↑E
	(calculator is ready to add more pairs)			

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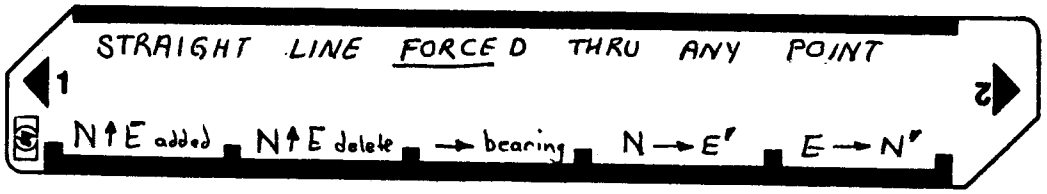

PROGRAM LISTING

☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	✦LBL "FOR CE"		
02	CLΣ		clear stat. reg.
03	"N↑E HEL D ?"		
04	PROMPT		
05	STO 08		
06	X<>Y		
07	STO 07		
08	✦LBL A		
09	"N↑E"		
10	PROMPT		
11	XEQ 09		shift origin
12	Σ+		
13	GTO A		
14	✦LBL 09		
15	STO 02		} shift origin
16	RCL 08		
17	−		
18	X<>Y		
19	STO 01		} shift origin
20	RCL 07		
21	−		
22	RTN		
23	✦LBL B		delete N, E
24	XEQ 09		shift origin
25	Σ−		
26	GTO A		
27	✦LBL C		compute slope
28	1		
29	RCL 15		
30	RCL 14		
31	/		
32	STO 04		slope
33	R−P		
34	X<>Y		azimuth
35	STO 01		
36	SIN		
37	ASIN		
38	ABS		
39	HMS		
40	STO 03		bearing
41	RCL 01		
42	90		
43	/		
44	1		
45	+		
46	INT		
47	STO 05		quadrant
48	FIX 4		
49	GTO IND 05		
50	✦LBL 01		"N E"
51	"N "		
52	GTO 03		
53	✦LBL 02		"S E"
54	"S "		
55	✦LBL 03		
56	ARCL 03		
57	"⊢ E"		
58	PROMPT		
59	✦LBL D		N → E'
60	FIX 3		
61	STO 09		
62	RCL 07		} shift origin
63	−		
64	RCL 04		
65	/		
66	RCL 08		
67	+		
68	STO 00		
69	"E: "		
70	ARCL 00		
71	PROMPT		
72	GTO D		
73	✦LBL E		E → N'
74	FIX 3		
75	STO 00		
76	RCL 08		} shift origin
77	−		
78	RCL 04		
79	*		
80	RCL 07		
81	+		
82	STO 09		
83	"N: "		
84	ARCL 09		
85	PROMPT		
86	GTO E		
87	.END.		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

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REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

0	E (→N')		
1	Ni , azimuth		
2	Ei		
3	bearing		
4	slope		
5	quadrant		
6			
7	N held		
8	E held		
9	N(→E')		
10			
11	ΣE		
12	ΣE^2		
13	ΣN		
14	ΣN^2		
15	ΣNE		
16	n		

STATUS

SIZE 017 TOT. REG. 47 USER MODE

ENG ____ FIX 3 SCI ____ ON ✓ OFF ____

DEG ✓ RAD ____ GRAD ____

FLAGS

#	INIT S/C	SET INDICATES	CLEAR INDICATES

ASSIGNMENTS

FUNCTION	KEY	FUNCTION	KEY

ROW 1 (1 - 3)

ROW 2 (3 - 8)

ROW 3 (8 - 13)

ROW 4 (14 - 24)

ROW 5 (24 - 33)

ROW 6 (34 - 45)

ROW 7 (46 - 53)

ROW 8 (54 - 59)

ROW 9 (60 - 69)

ROW 10 (69 - 76)

ROW 11 (77 - 85)

ROW 12 (86 - 87)