

Program Title TABLE LOOK UP USING LAGRANIAN INTERPOLATING POLYNOMIALContributor's Name RICHARD L ROBINSONAddress 912 CHESTNUT CIRCLECity WPAFBState/Country OHZip Code 45433

Program Description, Equations, Variables THIS PROGRAM IS DESIGNED FOR USE AS A SUBROUTINE TO INTERPOLATE IN TABLES OF X-Y PAIRS. THE INPUTS ARE THE DEGREE OF THE INTERPOLATING POLYNOMIAL (M), A TABLE LOCATION COUNTER (L), AND THE INDEPENDENT VARIABLE (X). THE TABLE OF X-Y PAIRS MUST BE LOADED PRIOR TO PROGRAM EXECUTION. DURING OPERATION, THE TABLE IS SEARCHED TO LOCATE THE X-TABLE ENTRIES NEAREST IN VALUE TO X. N IS THEN USED TO COMPUTE THE START AND STOP LOCATION (SUBSCRIPTS) OF THE X-Y PAIRS TO BE USED FOR THE INTERPOLATION. ADJUSTMENTS ARE MADE TO KEEP THESE VALUES WITHIN THE TABLE LIMITS. ERROR MESSAGES ARE DISPLAYED IF TABLE LIMITS ARE EXCEEDED. THE VALUE OF Y CORRESPONDING TO X IS APPROXIMATED AS FOLLOWS:

$$y \doteq \sum_{k=i_{\text{START}}}^{i_{\text{STOP}}} L_k(x) \cdot y_k; \text{ WHERE } L_k(x) = \prod_{\substack{J=i_{\text{START}} \\ J \neq k}}^{i_{\text{STOP}}} \frac{(x - x_J)}{(x_k - x_J)}$$

Necessary Accessories MEMORY MODULES ARE REQUIRED FOR TABLES WITH MORE THAN 18 X-Y PAIRS.

Operating Limits and Warnings IF M IS THE NUMBER OF X-Y PAIRS, THEN $0 \leq N \leq M-1$. THE X VALUES ARE LOADED AS A GROUP AND MUST BE IN INCREASING ORDER. THE Y VALUES MUST BE LOADED IN DATA REGISTERS THAT IMMEDIATELY FOLLOW THE X DATA REGISTERS. DATA REGISTERS 12 THRU 19 ARE USED FOR COMPUTATION.

Reference(s) CONTE, SD, ELEMENTARY NUMERICAL ANALYSIS, PP 71-73, Mc GRAW-HILL BOOK CO, 1965.

This program has been verified only with respect to the numerical example given in Program Description II. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

NEITHER HP NOR THE CONTRIBUTOR MAKES ANY EXPRESS OR IMPLIED WARRANTY OF ANY KIND WITH REGARD TO THIS PROGRAM MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NEITHER HP NOR THE CONTRIBUTOR SHALL BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH OR ARISING OUT OF THE FURNISHING, USE OR PERFORMANCE OF THIS PROGRAM MATERIAL.

(CONTINUATION PAGE)

PROGRAM DESCRIPTION (CON'D)

THE SUBSCRIPTS REFER TO THE TABLE VALUES (E.G. $x_1, y_1; x_2, y_2; \dots x_{m-1}, y_{m-1}; x_m, y_m$). THE PROGRAM USES DATA REGISTERS 12 THRU 19 FOR COMPUTATIONS; THUS, REGISTERS 00 THRU 11, AND 20 AND ABOVE MAY BE USED TO STORE TABLE VALUES. NOTE THAT X VALUES AND Y VALUES ARE STORED IN SEQUENTIAL DATA REGISTERS AS A GROUP. SEE SAMPLE PROBLEM FOR ILLUSTRATION.

AT THE START OF EXECUTION THE PROGRAM ASSUMES THE FOLLOWING STACK CONFIGURATION:

Z REGISTER CONTAINS N, THE DEGREE OF THE INTERPOLATING POLYNOMIAL.

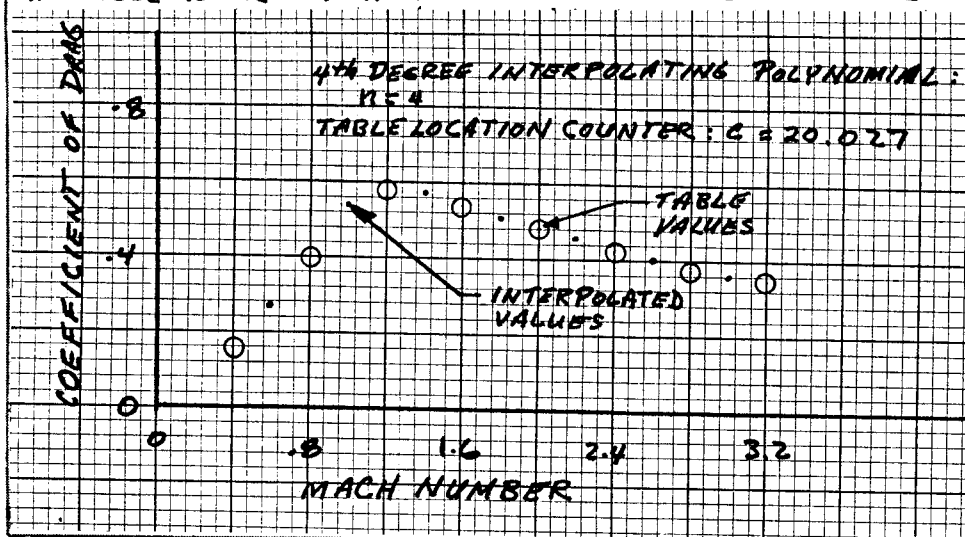
Y REGISTER CONTAINS C, A TABLE LOCATION COUNTER. C IS OF THE FORM $ffff.rrr$. WHERE $ffff$ IS THE NUMBER OF THE DATA REGISTER THAT CONTAINS THE FIRST TABLE VALUE OF X, AND WHERE rrr IS THE NUMBER OF THE DATA REGISTER THAT CONTAINS THE LAST TABLE VALUE OF X.

X REGISTER CONTAINS X, THE VALUE OF THE INDEPENDENT VARIABLE FOR WHICH A CORRESPONDING VALUE OF Y IS DESIRED.

SINCE THE TABLE LOCATION COUNTER DEFINES THE DATA REGISTERS TO BE USED FOR TABLE LOOK-UP AND INTERPOLATION, SEVERAL TABLES CAN BE LOADED INTO THE CALCULATOR AT THE SAME TIME. DURING EXECUTION, THE DESIRED TABLE IS SELECTED BY SETTING THE TABLE LOCATION COUNTER TO THE CORRECT VALUE.

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired) THE DRAG COEFFICIENT OF A SOUNDING ROCKET VARIES WITH MACH NUMBER AS SHOWN BELOW. SET UP PROGRAM TBL TO PERFORM A TABLE LOOK-UP AND FOURTH DEGREE INTERPOLATION.



MACH NO	DRA G COEF. (C _D)
.4	.17
.8	.40
1.2	.58
1.6	.54
2.0	.48
2.4	.43
2.8	.38
3.2	.35

SOLUTION:

Input	Function	Display	Comments
	XEQ SIZE 036		MINIMUM SIZE
.4	STO Z0	.400	M1
.8	STO Z1	.800	M2
.2	STO Z2	1.200	M3
1.6	STO Z3	1.600	M4
2.0	STO Z4	2.000	M5
2.4	STO Z5	2.400	M6
2.8	STO Z6	2.800	M7
3.2	STO Z7	3.200	M8
.17	STO Z8	.170	CD1
.40	STO Z9	.400	CD2
.58	STO Z0	.580	CD3
.54	STO Z1	.540	CD4
.48	STO Z2	.480	CD5
.43	STO Z3	.430	CD6
.38	STO Z4	.380	CD7
.35	STO Z5	.350	CD8
4	ENTER	4.000	4TH DEGREE INTERPOLATION
20.027	ENTER	20.027	TABLE LOCATION COUNTER
1	XEQ TBL	.537	VALUE OF C _D FOR M=1.0
4	ENTER	4.000	
20.027	ENTER	20.027	
.39	XEQ TBL	X < 0.400	ERROR MSG, M=.39 IS OUT OF TABLE
4	ENTER	4.000	
20.027	ENTER	20.027	
3.21	XEQ TBL	X > 3.200	ERROR MSG, M=3.21 IS OUT OF TABLE
8	ENTER	8.000	8TH DEG INTERPOLATION
20.027	ENTER	20.027	TABLE LOCATION COUNTER
1.0	XEQ TBL	N > TBL, X=3.200	ERROR MSG, 8TH DEG NOT POSSIBLE (N > M-1)
7	ENTER	7.000	7TH DEG INTERPOLATION
20.027	ENTER	20.027	TABLE LOCATION COUNTER
1.0	XEQ TBL	.530	VALUE OF C _D FOR M=1.0 USING 7TH DEGREE INTERPOLATING POLYNOMIAL

SAMPLE PROBLEM #2: WITHOUT CHANGING THE DRAG COEFFICIENT VS MACH NO. TABLE SET UP A TABLE OF INFLATION FACTORS VS FISCAL YEARS. ALSO, USE "TBL" AS A SUBROUTINE AND DEMONSTRATE USE OF TABLE LOCATION COUNTER.

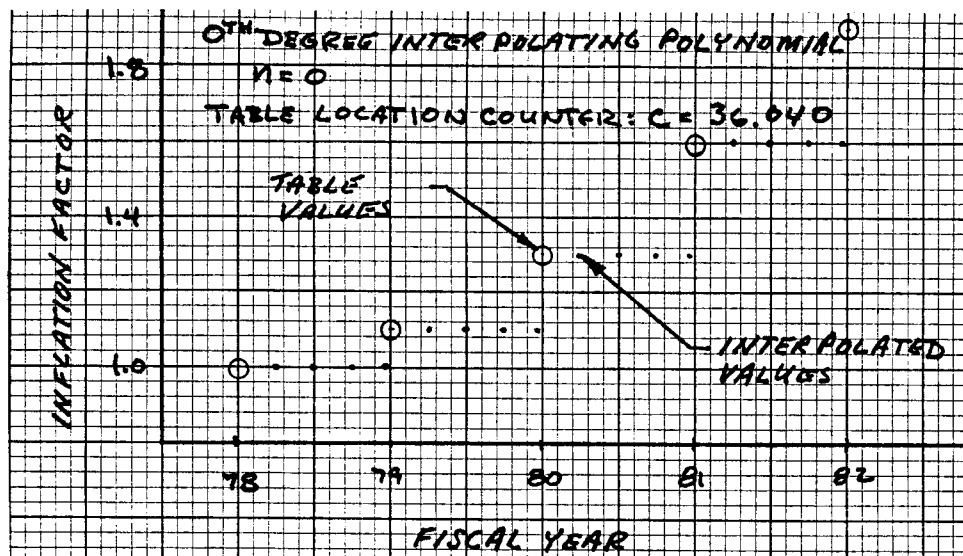


TABLE VALUES	
FISCAL YEAR	INFLATION FACTOR
78	1.0
79	1.1
80	1.3
81	1.6
82	1.9

INPUT	FUNCTION	DISPLAY	COMMENTS
	XEQ SIZE 046		MINIMUM SIZE
78	STO 36	78	YR1
79	STO 37	79	YR2
80	STO 38	80	YR3
81	STO 39	81	YR4
82	STO 40	82	YR5
1.0	STO 41	1.000	f1
1.1	STO 42	1.100	f2
1.3	STO 43	1.300	f3
1.6	STO 44	1.600	f4
1.9	STO 45	1.900	f5
PROGRAM LUK	GTO LUK		REFER TO PAGE 7 AND KEY
	FIX 2		IN PROGRAM LUK INTO MEMORY.
	USER		
0	A	0.00	DEGREE OF POLYNOMIAL
36.04	B	36.04	
78.1	C	X=78.10 Y=1.00	DISPLAY OF PGM LUK FOR YR=78.1, f=1.00
78.9	C	X=78.90 Y=1.00	
81.0	C	X=81.00 Y=1.60	
20.027	B	20.03	CHANGE C TO USE MACH NO. C0 TABLE
4	A	4.00	DEGREE OF POLYNOMIAL
1	C	X=1.00 Y=0.54	AT MACH=1.00; C0=0.54
3.3	C	X>3.20	ERROR MSG, M=3.3 IS OUT OF TABLE
1	C	1.00	WRONG ANSWER, CALCULATOR EXECUTED TO SINCE LBL C DOES NOT EXIST IN PROGRAM "TBL" TO RECOVER PRESS GTO LUK
	GTO LUK		
1	C	X=1.00 Y=0.54	LOCAL LBL A,B,C ARE NOW DEFINED SINCE POINTER IS NOW BACK IN PROGRAM LUK.

USER INSTRUCTIONS

[illegible]

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	*LBL TBL		STACK MUST BE LOADED AS FOLLOWS	51	STO 17		
	STO 16				*LBL 06		
	RDN		Z: N		RCL 18		
	STO 15		Y: C		RCL 17		
	STO 17		X: X		X < Y?		TEST: IS $i_{STOP} >$ TABLE LENGTH?
	STO 18				GTO 05		COMPUTES i_{START}
	RDN				RCL 18		
	STO 14				RCL 14		
	CLA				-		
10	"X2		ERROR MSG	60	RCL 15		
	RCL IND 18				INT		
	RCL 16				ST-17		REG 17 VALUE IS NUMBER OF X-Y PAIRS
	X < Y?		TEST: IS X < FIRST TABLE VALUE		X > Y?		TEST: IS $i_{START} <$ TABLE STARTING POINT
	GTO 03				GTO 03		
	*LBL 00				RCL 18		
	RCL 16				RCL 14		
	RCL IND 18				-		
	X <= Y?		LOOP TO SEARCH TABLE VALUES OF X. SEARCH WILL STOP WHEN AN i IS FOUND SUCH THAT $X_i \leq X_{i+1}$		ST+17		
	GTO 01				RCL 18		
20	GTO 04			70	G3		
	*LBL 01				/		
	/				+		
	ST+18				STO 18		ISG VALUE FOR INTERPOLATION LOOP
	ISG 17		REG 18 CONTAINS $i+1$.		STO 14		ZERO Y SUMMATION REGISTER
	GTO 00				0		
	RDN				STO 19		
	X = Y?				GTO 07		
	GTO 04				*LBL 05		
	/				/		
30	ST-18		REG 18 CONTAINS i	80	ST-18		REDUCE i_{STOP} BY 1 AND TEST AGAIN.
	CLA				GTO 06		
	"X>		ERROR MSG		*LBL 07		
	*LBL 03				/		INITIALIZE P _i PRODUCT REGISTERS
	RCL IND 18				STO 13		
	BEEP		PROGRAM STOPS EXECUTION ON ANY ERROR MSG		STO 12		
	PROMPT				ST+17		REG 17 CONTAINS VALUE OF Y REGISTER CORRESPONDING TO THE CURRENT X_k .
	*LBL 04				RCL 14		
	CLA				STO 15		
	"N>TBL,X=		ERROR MSG		*LBL 09		
40	RCL 18			90	RCL 18		
	/				RCL 15		
	-				X = Y?		TEST: IS $i = k$?
	INT				GTO 08		
	RCL 14				RCL 16		X
	+		COMPUTES i_{STOP}		RCL IND 15		X_i
	STO 18				-		i_{STOP}
	RCL 15				ST * 13		$\prod (X - X_i)$
	FRC				RCL IND 18		$j = i_{START}$
	E3				RCL IND 15		$i \neq k$
50	*			100	-		

☒ 67 ☐ 97 ☐ 41C

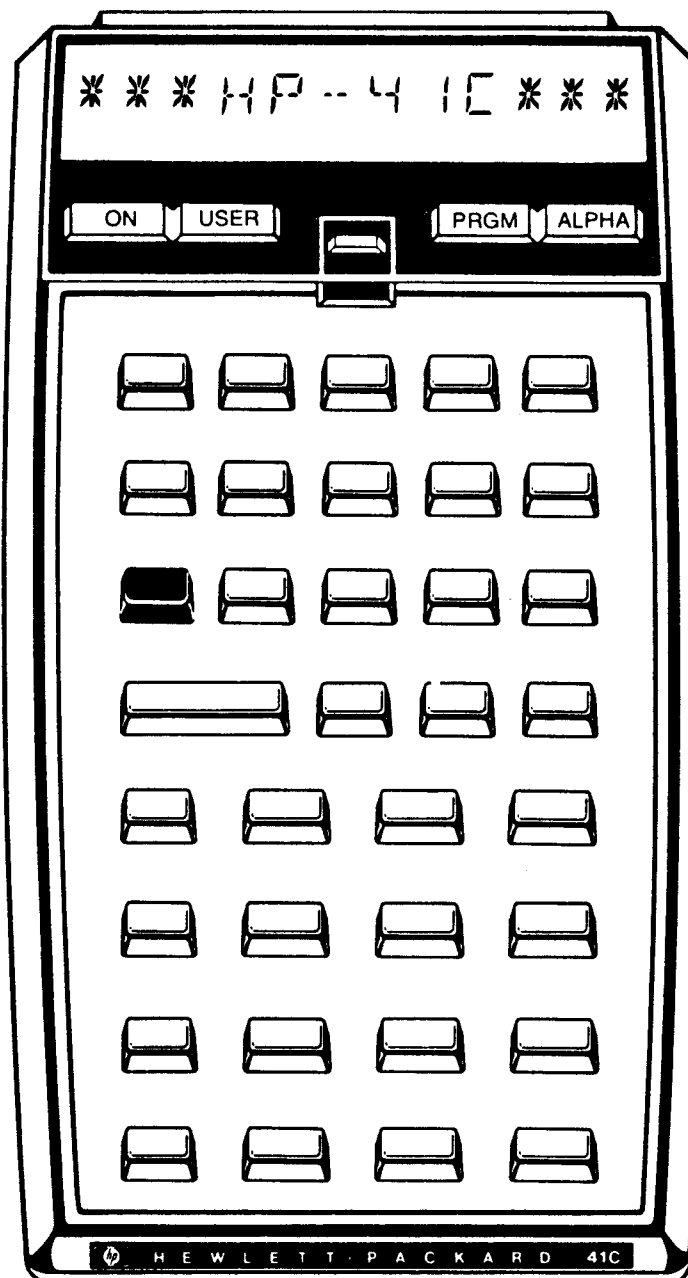
[illegible]

Page 8 of 9

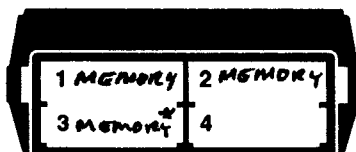
[illegible]

KEYBOARD CARD LABELING

KEYBOARD



SYSTEM
CONFIGURATION



* ADDITIONAL MEMORY WILL
BE REQUIRED FOR LARGE
TABLES. EACH MODULE CAN
STORE 32 X-4 PAIRS.

CARD

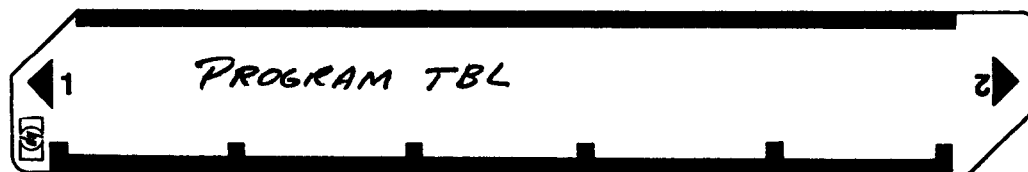


TABLE LOOK UP USING LAGRANIAN
INTERPOLATING POLYNOMIAL
PROGRAM REGISTERS NEEDED: 27

USERS' LIBRARY
PROGRAM NUMBER: 00367C

PAGE 1
OF 1

ROW 1 (1 - 5)



ROW 2 (6 - 13)



ROW 3 (14 - 21)



ROW 4 (22 - 30)



ROW 5 (30 - 39)



ROW 6 (39 - 43)



ROW 7 (44 - 52)



ROW 8 (53 - 61)



ROW 9 (62 - 69)



ROW 10 (70 - 77)



ROW 11 (78 - 87)



ROW 12 (88 - 96)



ROW 13 (97 - 104)



ROW 14 (104 - 113)



ROW 15 (113 - 115)



